Space Weather Technical Forecast

Issued on Wednesday, 06 July 2022 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight but increasing chance of R1-R2 radio blackouts. Chance of Minor Geomagnetic Storms. Increasing chance of Active fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours. The most significant event was a C7.5 at 05/1238UTC from AR3053. There are currently six sunspots on the visible disc, with the most complex is AR3053, which is rotating around the northeast limb, although its currently difficult to fully access due to the viewing angle. All other remaining regions are relatively small and stable. However, a C9.8 flare from AR3047 (which has now faded and no longer appears on current analysis) produced a Type II and IV radio burst along with a dimming in AIA211 on the 5th July, which produced a very faint partial halo CME in coronagraph imagery. This has been analysed and may give a glancing blow at Earth on Day 3 (08 July), although confidence is low. No other Earth-directed CMEs have been observed in available imagery over the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, has remained at background levels, with a steady decline from 375km/s to 330km/s, before the likely start of a CIR, ahead of the CH97/+ HSS. The density was initially mostly average, but started to rise from 05/1800 UTC, peaking around 21 ppcc at 06/0649UTC, before a steady decline back towards average. The IMF was weak throughout but with a recent increase to 9 nT, with the all important north-south component (Bz) varying weakly and mostly northward directed, until the end of the period, where its become weakly southward directed. The phi angle was predominantly negative (towards the Sun), with some brief variations, then switched to positive at 05/2150 UTC. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES-16, remained at Background levels throughout the period.

The high energy electron flux (greater than 2MeV) has also been at background levels through the last 24 hours. Electron fluence was well below the Active (1e8 integrated pfu) threshold. Observed fluence was 2.44e6 integrated pfu at 06/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Expected to be Low, with a Slight Chance of isolated M-class flares. An increase is probable through the period as returning regions potentially rotate onto the eastern limb.

Solar Wind / Geomagnetic Activity: Earth may experience a glancing blow from the CME which occurred at 05/0407 UTC from AR3047 (which has now faded). This CME was difficult to assess, however it gave a faint partial halo in SOHO imagery and as such a low confidence glancing blow is possible on Day 3 (08 July). Otherwise, solar winds are anticipated to increase from background to elevated levels as CH97/+ becomes geoeffective, most likely during Day 1

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(06 July). Elevated or slightly elevated wind speeds could last for much of this period. Geomagnetic activity is likely to increase during Day 1 from initially Quiet to Active, with a Chance of G1/Minor Storm interval(s), these most likely on Days 1 and 3 (06 and 08 July) as the HSS arrives on Day 1 and the possible glancing blow from a CME on Day 3.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the high energy proton flux (greater than 10 MeV) is expected to remain at background levels.

High energy electron flux (greater than 2MeV) is currently at background levels. However, there is an increasing chance of high (1000 pfu) flux levels being reached during the forecast period due to anticipated high speed stream influence. Electron fluence is considered most likely to remain below the Active (1e8 integrated pfu) threshold, but with an anticipated rising trend. Potential CME effects on Day 3 (08 July) may temporarily suppress electron levels however.

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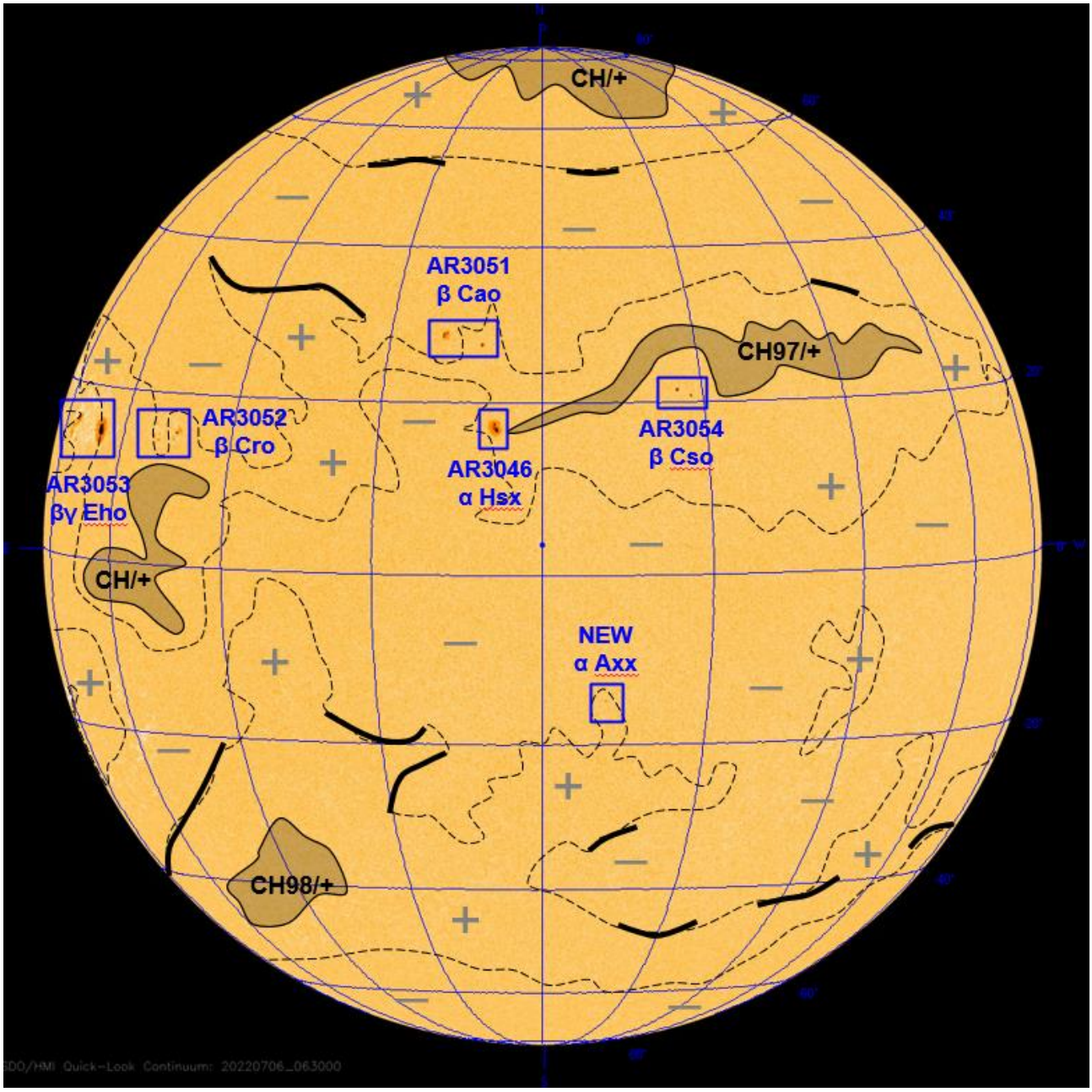
Figure 1. Solar Analysis Valid 06/0630UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth may experience a glancing blow from a CME which occurred at 05/0407 UTC from AR3047. This CME was difficult to assess as it was faint and contaminated by a far sided CME which was visible at the same time. However, it gave a faint partial halo in SOHO imagery and as such a low confidence glancing blow is possible on day 3 (08 July).

Otherwise, solar winds are anticipated to increase from background to slightly elevated or possibly elevated levels as CH97/+ becomes geoeffective, most likely during Day 1 (06 July) as there are possibly signs of a CIR currently occurring. The longitudinal extent of this CH suggests that slightly elevated or elevated wind speeds could last for much of this period. However, recent STEREO A data is not showing any particular enhancement, although STEREO is further south than Earth relative to the Sun's equator (with CH97/+ in the northern solar hemisphere). Overall, geomagnetic activity is likely to increase during Day 1 (06 July) to be Quiet to Active possibly with the odd G1/Minor Storm interval, these most likely on Days 1 and 3 (06 and 08 July) as the HSS arrives on Day 1 and the possible CME on Day 3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
05/0934	Partial	AR3047	SW quadrant	630 km/s	08/1200UTC	Low confidence glancing blow possible.

Figure 2: ENLIL and Ensemble shows possible CME glancing blow on 8th July.

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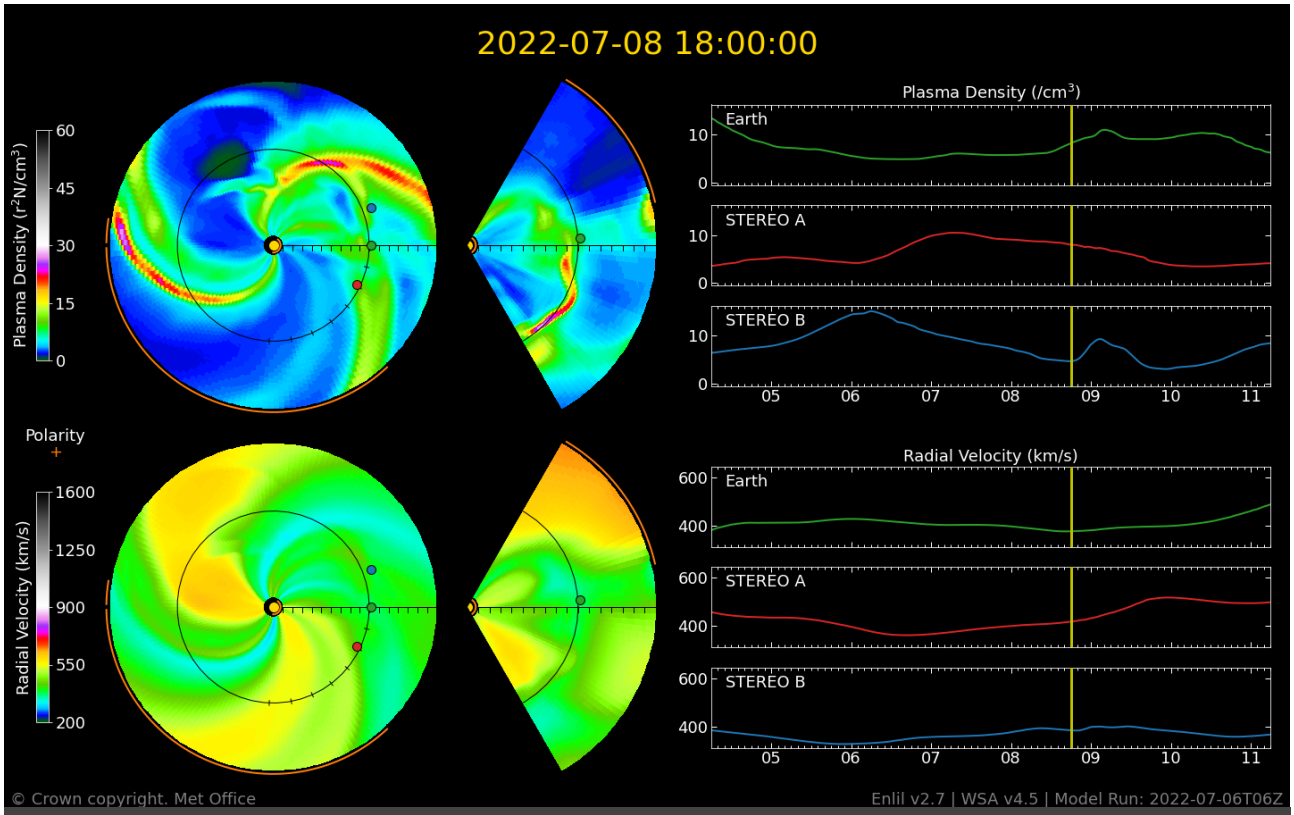

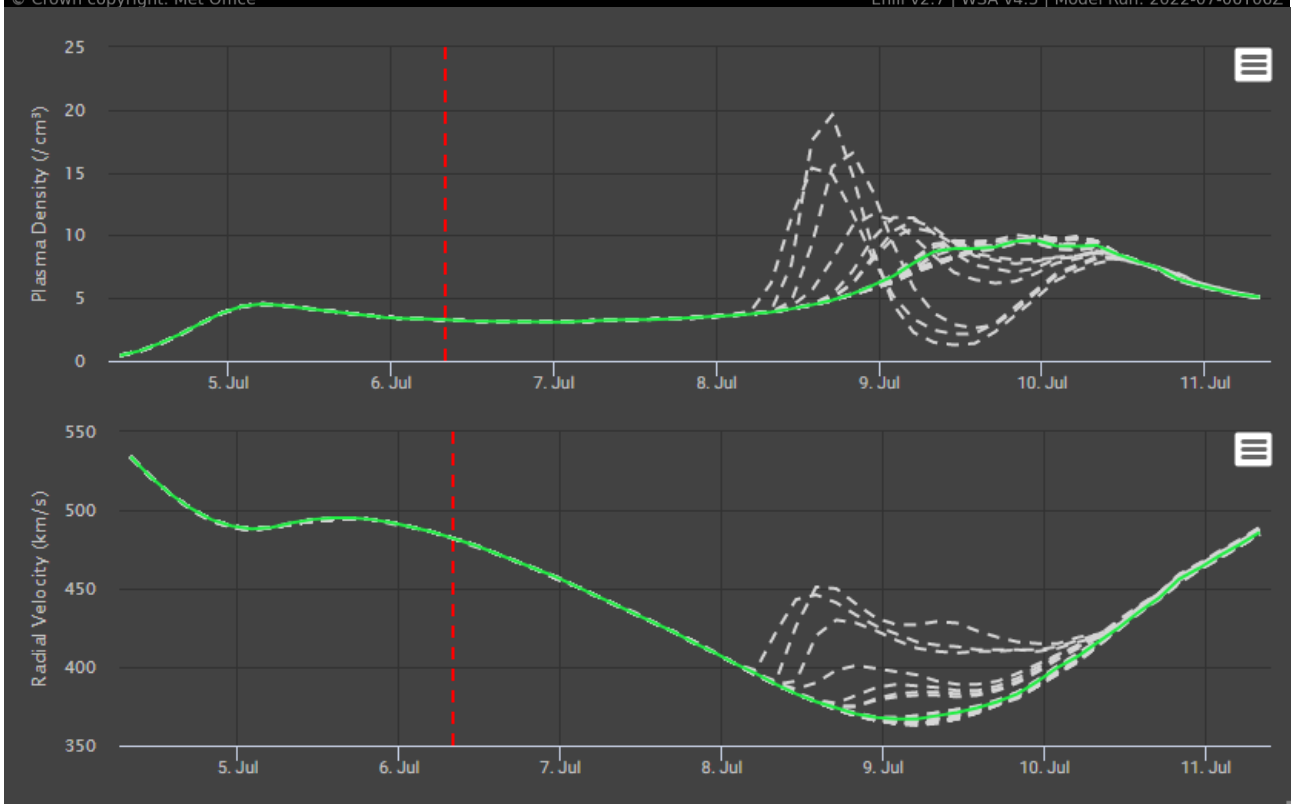

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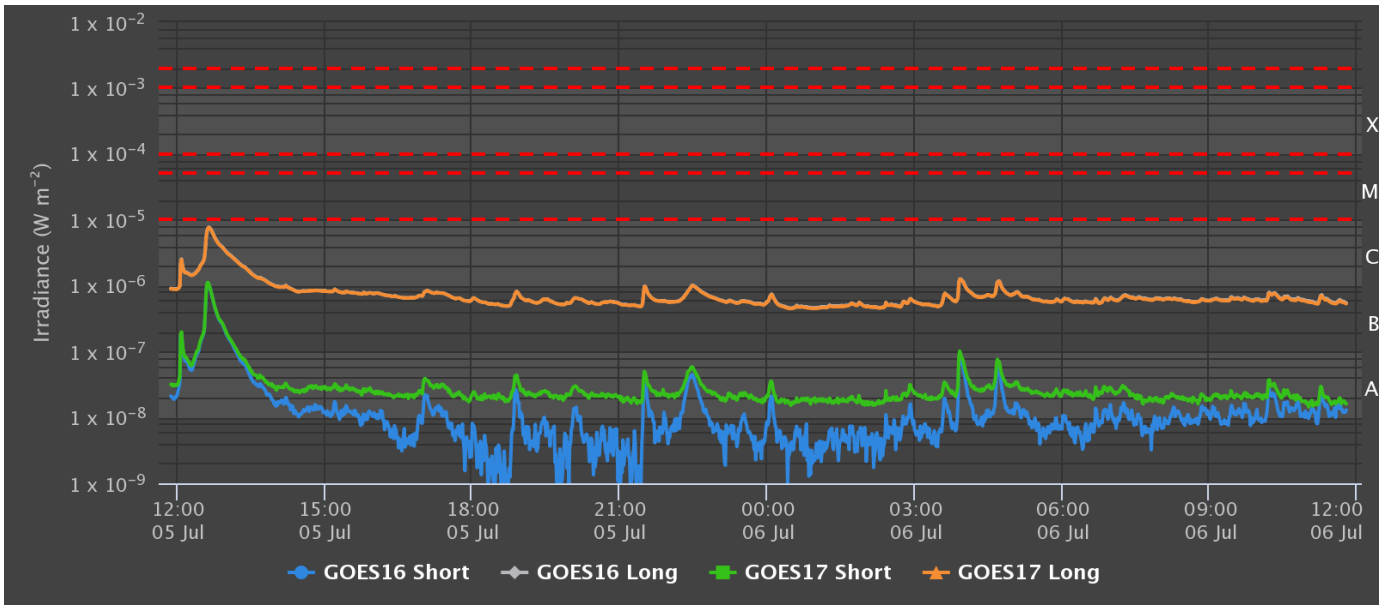
Radio Blackouts - X-Ray Flares:
There are currently six sunspot regions on the visible disc, which should increase in the coming four days, with potential returning sunspot groups due over the eastern limb and no groups of significance departing. The most interesting region currently visible is AR3053 (Eho/Beta-Gamma) in the northeast, which is difficult to fully access until it rotates further onto the visible disc. The contribution from eastern limb arrivals (seen in far-sided imagery) is difficult to judge until they become visible, but a slight uptick in probabilities is suggested to reflect this risk. C-class flares are expected, with a slight but increasing chance of M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	1	2	5	5

Figure 3: GOES X-Ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development. The main regions of interest are all in the eastern hemisphere at present, with any increase in proton risk not expected until the very end of the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	2
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at background levels. Electron flux is likely to increase through this period with anticipated elevated wind speeds from CH97. However, a low confidence CME glancing blow is possible early on Day 3 (08 July), which would suppress flux levels if it occurs. Overall, High (1000 pfu) flux levels may be reached during this period, but with some uncertainty due to the potential CME effects.

Electron fluence is currently well below the Active threshold. Fluence is considered most likely to remain below the Active threshold through the period, although this carries a degree of uncertainty due to the significant difference in coronal hole extent compared to the previous rotation and the possibility of CME effects. An upward trend is assessed as being likely following anticipated coronal hole connection but with low confidence for the magnitude of this. REFM is not currently showing any increase in fluence levels as we haven't yet seen an increase in wind speeds from CH97, so this is likely to be an underestimate at this time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	30	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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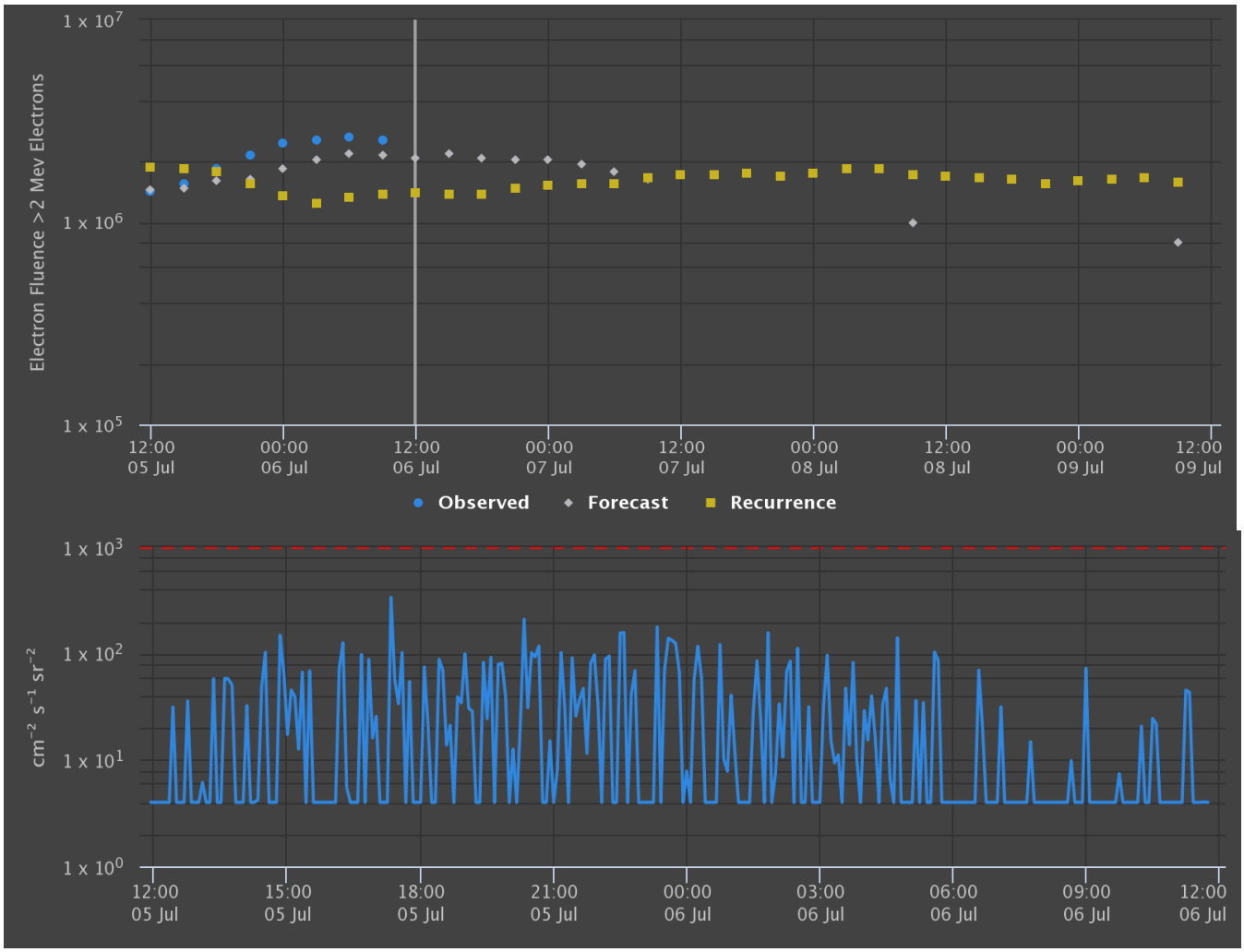
Figure 4: REFM electron fluence and Electron flux



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